

Contaminated Sediments: How do we get from determination of risk to cleanup?

June 5, 2002

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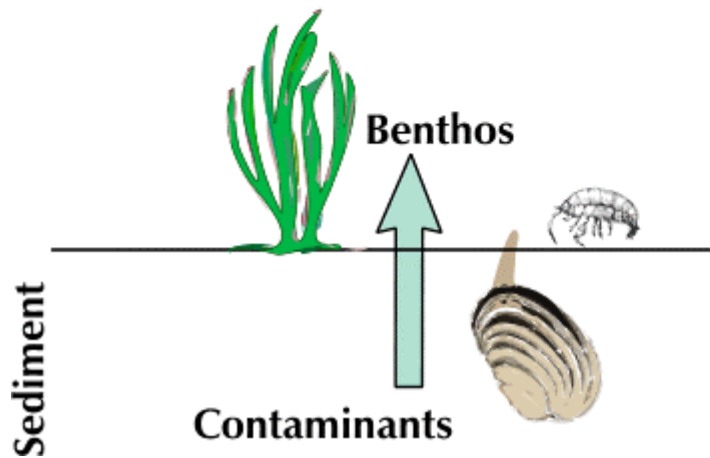
Windward Environmental



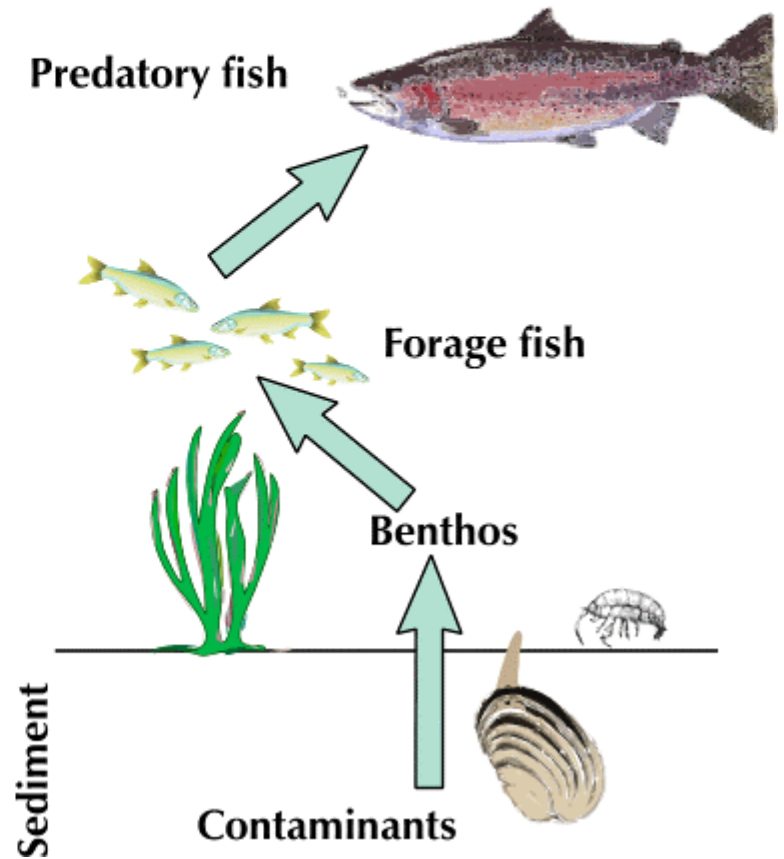
Risk-to-Cleanup: Sediment Exposure Pathways

- Direct: Exposure principally from direct contact with sediment
- Indirect: Exposure to contaminants in sediment indirect, usually through food chain

Direct Exposure Pathway



Indirect Exposure Pathway



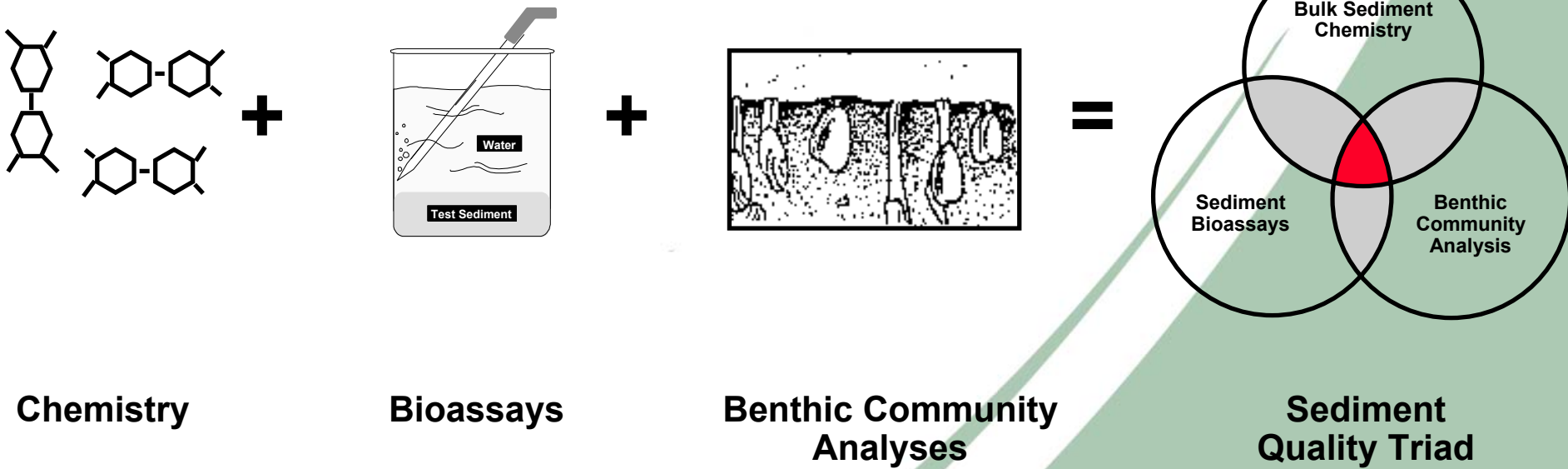
Risk-to-Cleanup: Direct Pathway Example

- Infaunal and epibenthic benthic organisms
- Exposure pathways include:
 - Interstitial water – complete; estimated as part of whole sediment exposure
 - Feeding – complete; estimated as part of whole sediment exposure
 - Sediment – complete
- Exposure range/duration: limited range and continuous exposure

Risk-to-Cleanup: Direct Pathway

- Options for establishing cleanup goals
 - Numeric-based decisions
 - Existing SQGs
 - Site-specific SQGs
 - Biological-based decisions
 - Bioassays
 - Benthic community analysis
 - Sediment Quality Triad

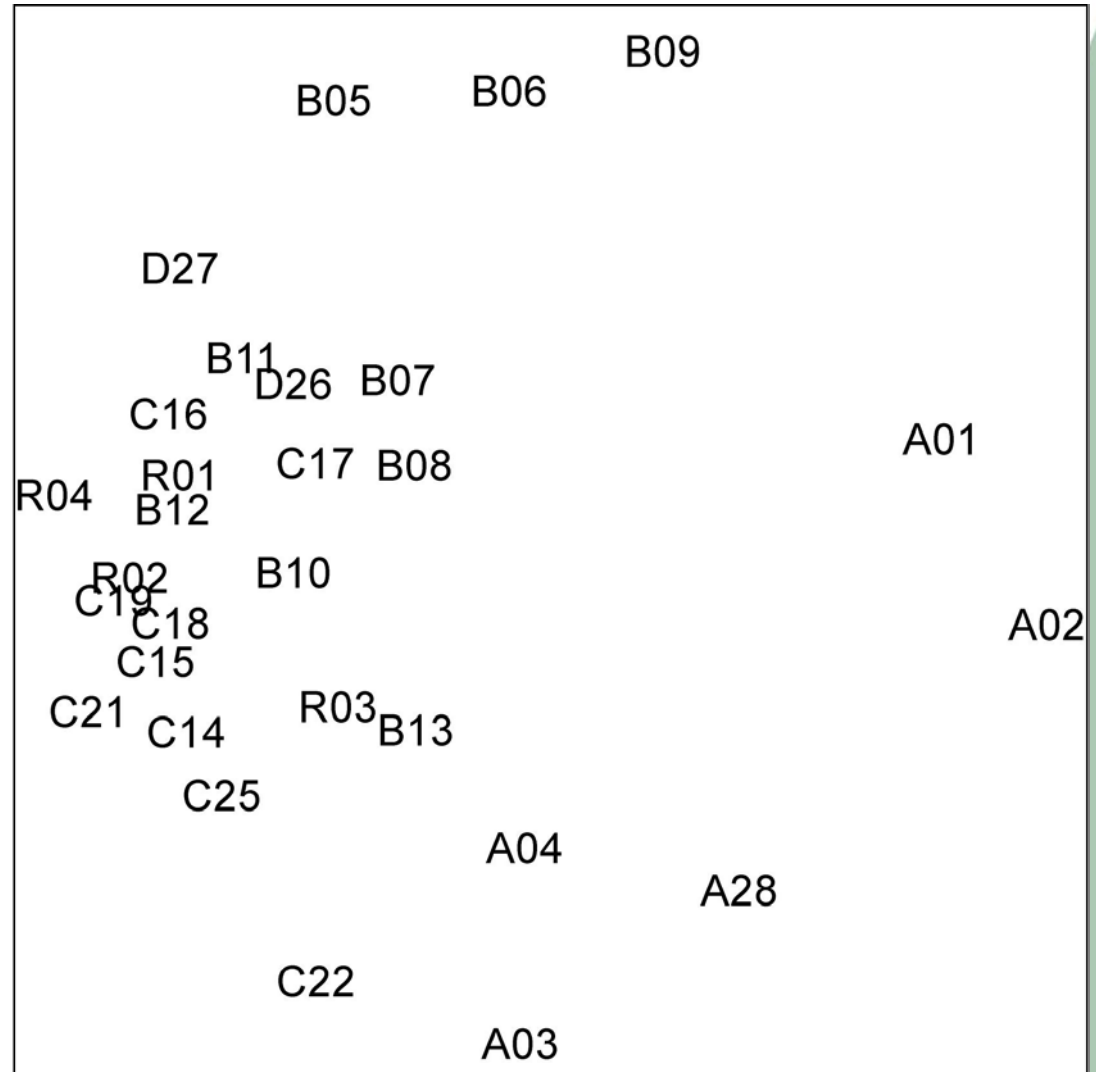
Overview of the Sediment Quality Triad process



Risk-to-Cleanup: Direct Pathway

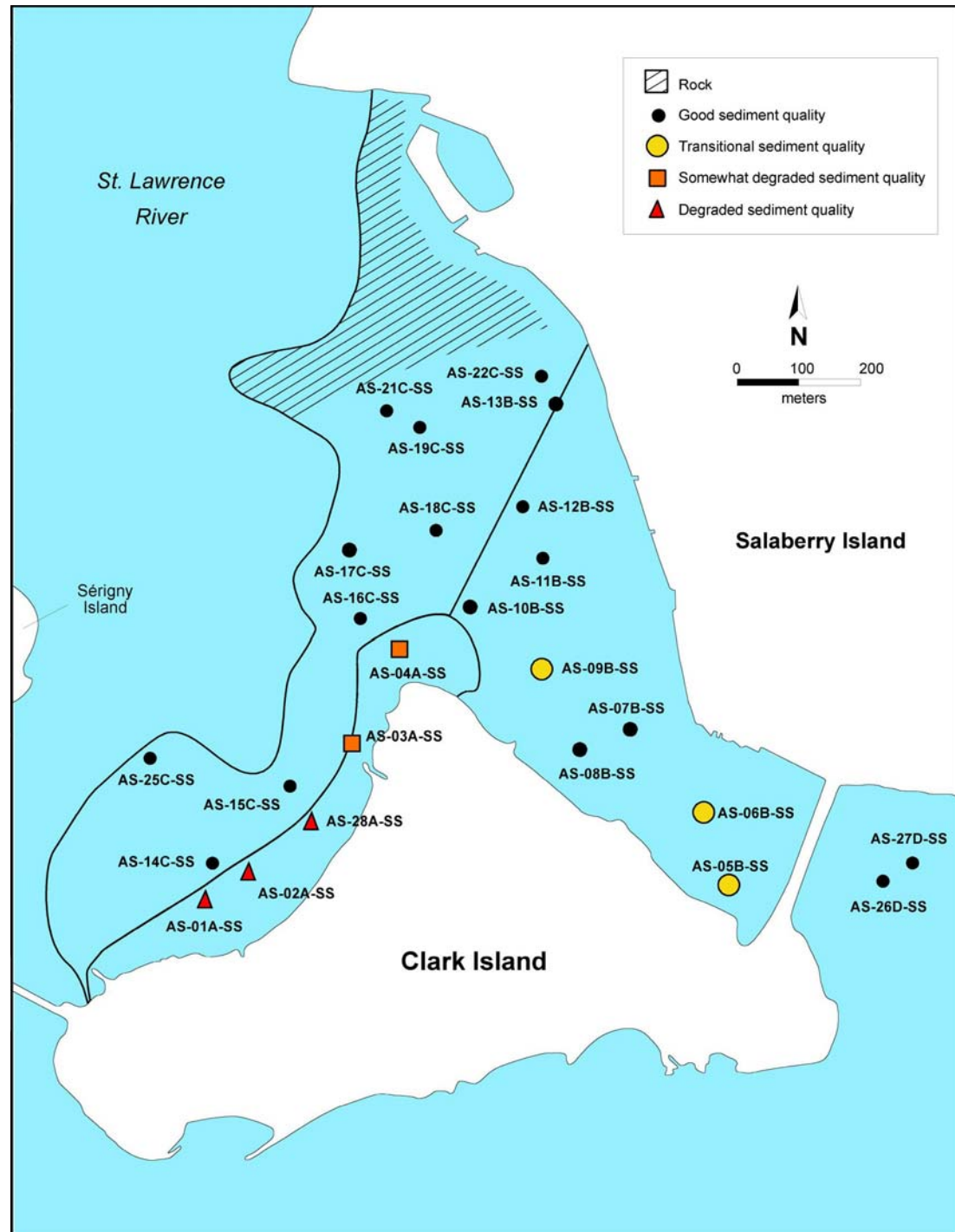
- Options for establishing cleanup footprint
 - GIS mapping
 - Thiessen polygons
 - Inverse distance weighting
 - Natural neighbor analysis
 - Multivariate statistics and spatial scaling
 - Use of multiple variables associated with TRIAD data to differentiate areas of varying sediment quality

Two-dimensional representation of the 10 Triad endpoints using multidimensional scaling



Note: station numbers in this diagram are given in the form Study Area + number.
Thus AS-01A becomes A01 and AS-25C becomes C25.

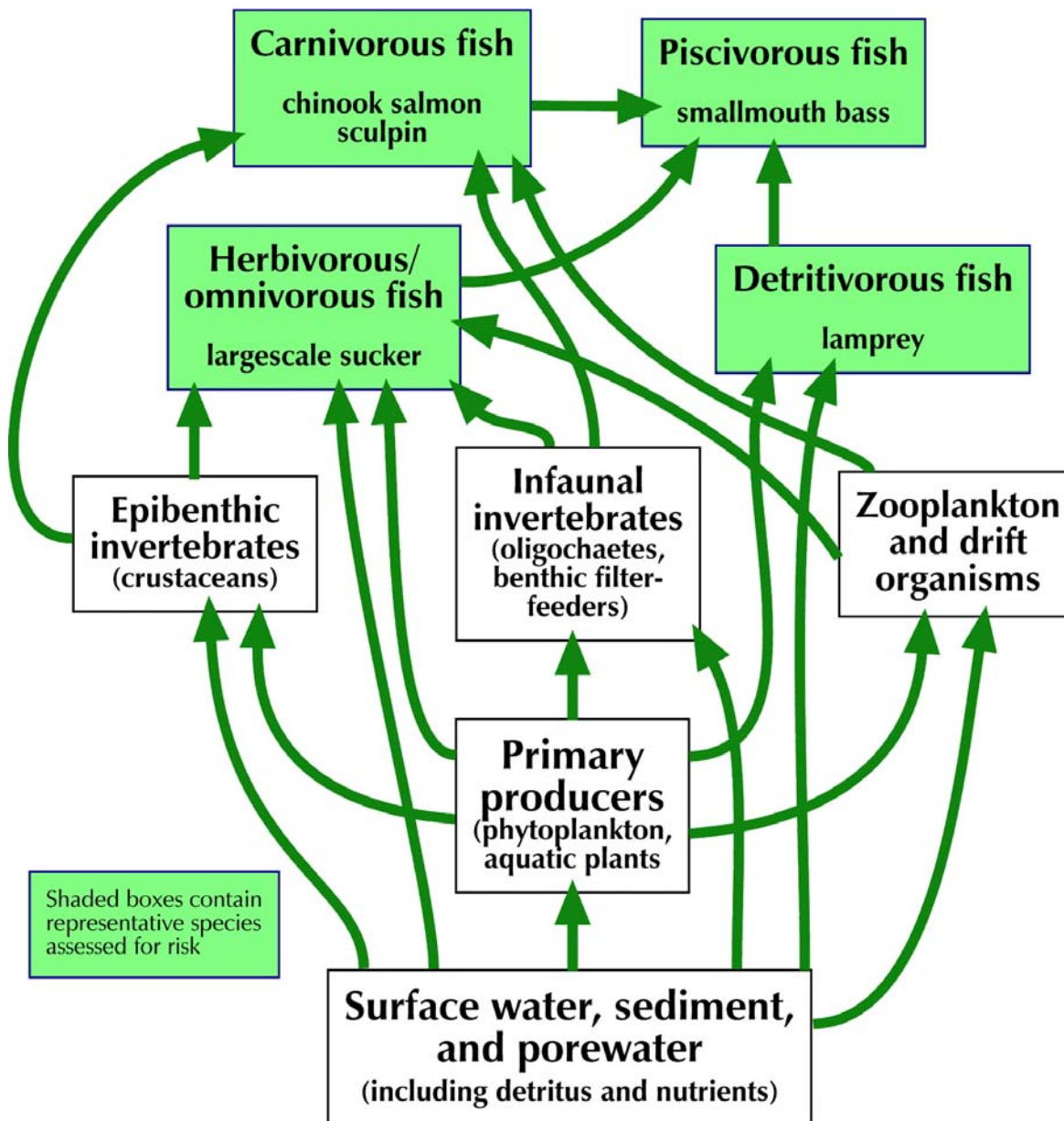
Grades of sediment quality



Risk-to-Cleanup: Indirect Pathway Example

- Fish and wildlife species
- Exposure pathways include:
 - Water – complete and potentially significant
 - Feeding – complete and probably significant
 - Sediment – complete for some species and possibly significant
- Exposure range/duration: potentially large home range and varying exposure
- Exposure through prey items is probably the greatest pathway for exposure

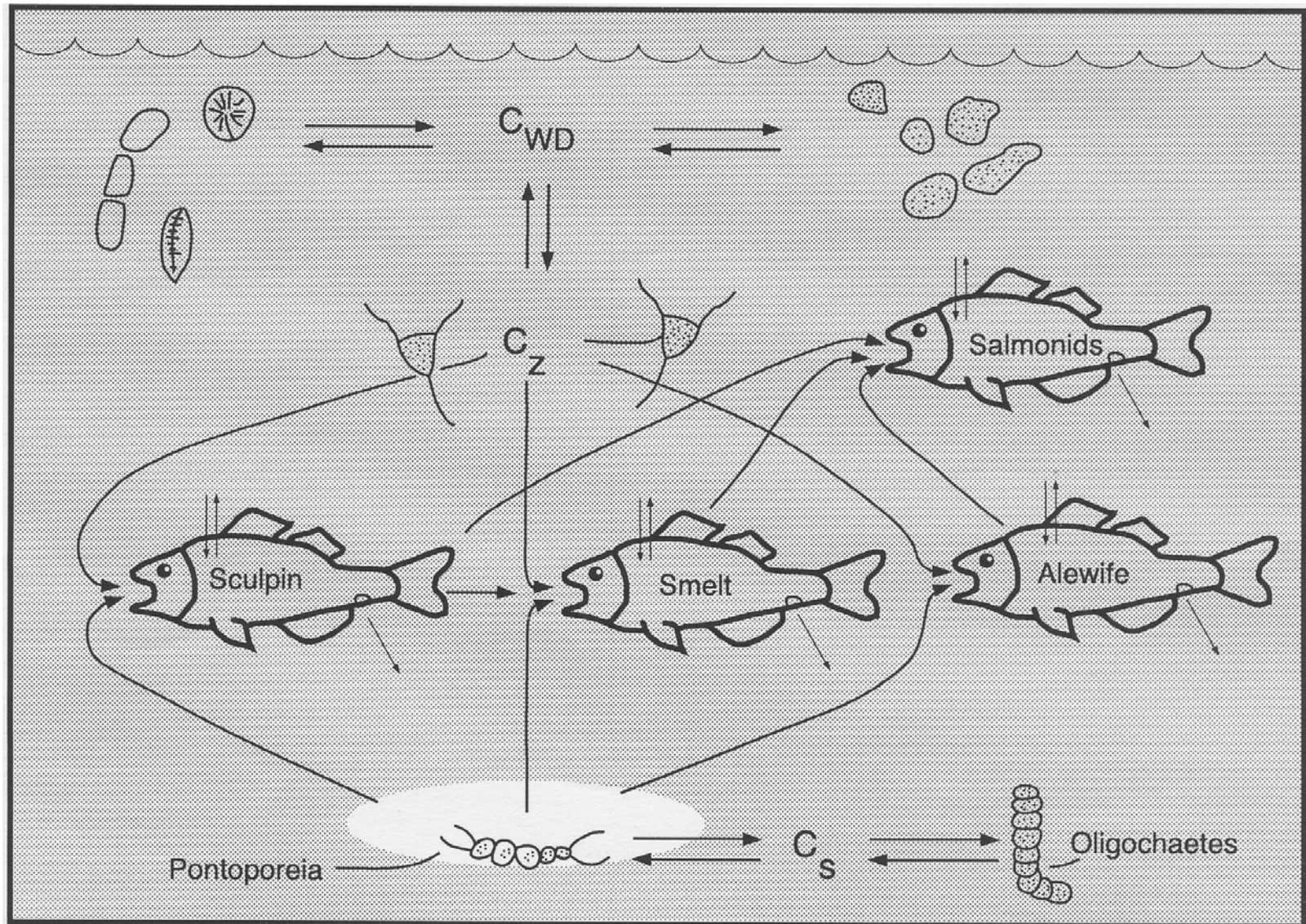
Fish food-web model



Risk-to-Cleanup: Indirect Pathway

- Options for establishing cleanup goals
 - Estimate total mass, remove hot spots
 - BSAFs
 - Food-web models

Conceptual bioaccumulation model



After Gobas, 1993

Risk-to-Cleanup: Indirect Pathway

- Options for establishing cleanup footprint
 - For mass removal, footprint not risk-based; size negotiated with agencies
 - For BSAFs, GIS mapping similar to direct pathways can be used
 - For food-web model
 - Focus on hot spot removal to reduce area-weighted concentration
 - Assuming adequate site-use information available, apply hypothetical are-weighted concentrations derived in GIS

Risk-to-Cleanup: Use of BSAFs

- Don't recommend stand alone use of BSAFs to establish sediment cleanup goals
 - Assumes steady state equilibrium between fish tissue and sediment
 - Most applicable to organisms with limited home range and strongly associated with sediment
 - For species with large home range location of greatest exposure is probably not sampling location. Need to calculate exposure concentration that reflects feeding patterns.